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Specification

[Title of the Invention]

Ink Jet Recording Method and Ink Jet Apparatus

[Claims]

1. An ink jet recording method, in which a recording head comprising a plurality of aligned ink ejecting orifices is repeatedly moved in a scanning manner in the direction different from the direction in which the ink ejecting orifices are aligned, to incrementally form an image by sequentially forming a plurality of image sections, being characterized in that in order to form an image, in which the borders between two adjacent image sections corresponding to two adjacent scanning tracks of the ink jet recording head are as imperceptible as possible,

the portion of binary image formation data corresponding to one or both of the first and last rasters of a given scanning track of the recording head is divided into a plurality of processual binary data units equivalent to a predetermined number of dots;

the theoretical amount by which ink is to be ejected from the set of ink ejecting orifices

corresponding to each processual binary data unit is calculated from the processual binary data unit; and

the amount, by which ink is ejected from the set of ink ejecting orifices corresponding to the processual binary data, is reduced, based on the calculated theoretical amount, in a manner to reduce the dot count of the image section corresponding to the processual data unit.

2. An ink jet recording method, in which a plurality of recording heads comprising a plurality of aligned ink ejecting orifices are repeatedly moved in a scanning manner in the direction different from the direction in which the ink ejecting orifices are aligned, to incrementally form a plurality of images different in colors, by sequentially forming a plurality of image sections, being characterized in that in order to form an image, in which the borders between two adjacent image sections corresponding to two adjacent scanning tracks of the ink jet recording head are as imperceptible as possible,

the portion of binary image formation data corresponding to one or both of the first an last raster of a given scanning track of the recording head is divided into a plurality of processual binary data units equivalent to a predetermined number of dots; and

a correction process, in which the amount, by which ink of a given color is ejected from the set of ink ejecting orifices corresponding to each processual binary data unit, is reduced, based on the calculated theoretical amount by which the ink of the given color is to be ejected from the set of ink ejecting orifices corresponding to the processual binary data unit, according to the given processual binary data unit, and the total of the amounts by which the inks of the colors other than the given color are ejected, according to the same processual binary data unit, is sequentially repeated for all the processual binary data units and all the colors, in a manner to reduce the dot count of the image section corresponding to the processual data unit for each color.

3. An ink jet recording method according to Claim 2, wherein the dot count of the image section corresponding to a given processual binary data unit is reduced with reference to a correction table prepared for each color in advance to show the relationship among the amount by which the ink of a given color is ejected by the set of ink ejecting orifices corresponding to the given processual binary data unit, the total of the amounts by which the inks of the colors other than the given color are ejected by the sets of ink ejecting orifices for the inks of

the other colors corresponding to the same processual binary data unit, and the correct amount by which the ink of the given color should be ejected.

4. An ink jet recording apparatus, which repeatedly moves a recording head comprising a plurality of aligned ink ejecting orifices, in a scanning manner in the direction different from the direction in which the ink ejecting orifices are aligned, to incrementally form an image by sequentially forming a plurality of image sections, being characterized in that in order to form an image, in which the borders between two adjacent image sections corresponding to two adjacent scanning tracks of the ink jet recording head are as imperceptible as possible, the ink jet recording apparatus comprises:

means for dividing the portion of binary image formation data corresponding to one or both of the first and last rasters of a given scanning track of the recording head, into a plurality of processual binary data units equivalent to a predetermined number of dots, and calculating the theoretical amount by which ink is to be ejected from the set of ink ejecting orifices corresponding to each processual binary data unit, based on the processual binary data unit; and

dot-thinning means for reducing the amount,

in terms of dot count, by which ink is ejected from the set of ink ejecting orifices corresponding to the processual binary data, based on the calculated theoretical amount, in a manner to reduce the dot count of the image section corresponding to the processual data unit.

5. An ink jet recording apparatus according to Claim 4, wherein said dot-thinning means carries out the dot-thinning process by referring to correction tables prepared in advance to show the relationship between the calculated theoretical amount by which ink is ejected, and the correct amount by which ink should be ejected.

6. An ink jet recording apparatus according to Claim 5, wherein said correction tables are independently prepared for each of the primary colors.

7. An ink jet recording apparatus according to Claim 5 or 6, wherein said correction tables show the relationship among the amount by which the ink of a given color is ejected by the set of ink ejecting orifices corresponding to a given processual binary data unit, total of the amounts by which the inks of the primary colors other than the given color are ejected by the set of ink ejecting orifices for the

other colors, according to the same processual binary data unit, and, correct amounts by which the ink of the given primary color should be ejected.

8. An ink jet recording apparatus according to Claim 5, 6, or 7, wherein a plurality of correction tables are prepared according to recording conditions inclusive of at least recording medium type, and are selectively used according to the recording conditions.

9. An ink jet recording apparatus according to any of Claims 4 - 8, wherein the priority order in which the dots corresponding to each processual binary data unit are eliminated is predetermined according to dot position.

10. An ink jet recording apparatus according to Claim 9, wherein if the dots corresponding to the first and last rasters of a given scanning track are the targets of the dot-thinning process, the first and last rasters are made different from each other in the priority order in which the dots corresponding each processual binary data unit are eliminated.

[Detailed Description of Invention]

[Field of the Invention]

The present invention relates to an ink jet recording apparatus employing a single-pass recording method.

[Description of the Prior Art]

Generally speaking, when forming an image using an ink jet recording apparatus, a recording head comprising a plurality of aligned ink ejecting orifices from which ink is ejected is repeatedly moved in a scanning manner in the direction different from the direction in which the ink ejecting orifices are aligned. Therefore, each scanning run of the recording head in the primary scanning direction results in the formation of an image section in the form of a band. As each image section is formed, ink sometimes bleeds at the edges of the image section in the form of a band, due to recording medium properties, for example, surface condition. Thus, the so-called "border streak", a type of image defect, is sometimes created between two adjacent image sections.

All that is necessary to prevent the occurrence of this defect is to employ one of the multi-pass recording methods in which a given portion of an image equivalent in size to the above described image section in the form of a "band" in a single-pass method is completed by moving the recording head a plurality of times in the primary scanning direction,

across the portion of recording medium corresponding to the given portion of the image. However, the employment of a multi-pass recording method reduces recording speed, which is a problem.

[Problems to be Solved by the Invention]

There are various technologies for preventing the occurrence of the border streak in a single-pass ink jet recording apparatus. For example, there is the technology disclosed in Japanese Laid-open Patent Application 7-89099. This technology prevents the occurrence of the border streak by reducing the amount of ink bleeding by reducing the values of the recording signals (multi-value signals) for recording the image section straddling the border between two adjacent "bands".

This method, however, suffered from the following faults because the attempt to prevent the occurrence of the border streak was made at the image formation signal level.

That is, first, most of the widely used ink jet recording apparatuses are connected, as peripheral apparatuses, to a computer or the like. Thus, the image formation data are processed by the computer or the like (for example, converted into binary data), and are transferred to an ink jet recording apparatus to record images. Also, providing an ink jet recording apparatus with an image formation

data input portion or image formation data processing portion, which processes multi-value signals, increases the cost of the apparatus, as well as the signal processing time of the apparatus. Thus, providing an ink jet recording apparatus for the general public with such a data processing portion is not practical. In addition, the prevention of the border streak at the image formation signal level requires an ink jet recording apparatus to spend a substantial amount of time to convert multi-gradation image formation data into binary image formation data; in other words, it wastes time, reducing recording speed. In comparison, an ink jet recording apparatus in accordance with the present invention does not prevent the border streak at the multi-value image formation signal level. Instead, it targets binary image formation data in order to prevent the border streak.

Second, all ink jet recording apparatuses are not the same in properties, for example, the distance by which recording medium is moved in the secondary scanning direction, and also, all recording media are not the same in properties. Thus, all ink jet recording apparatuses and recording media are not the same in the amount by which ink bleeds. Thus, it is difficult to satisfactorily prevent the border streak with the use of the above described prior technology.

Further, unless precise information regarding the borders between two adjacent scanning tracks of a given ink jet recording apparatus is available, it is very difficult to make corrections with the use of the host apparatus such as a computer.

Thus, the present invention was made to solve the above described problem, and its object is to provide a single-pass ink jet recording apparatus capable of preventing the occurrence of an unwanted streak at the border between two adjacent image sections, by processing binary image formation data on the side of an image recording apparatus.

Another object of the present invention is to provide a single-pass ink jet recording apparatus capable of minimizing the possibility that an unwanted streak will appear at the border between two adjacent bands of image sections due to the variances among ink jet recording apparatuses, and the variance in bleeding among recording media, by processing binary image formation data on the ink jet recording apparatus side.

[Means for Solving Problems]

According to the present invention made to accomplish the above described objects, an ink jet recording method, in which an image is incrementally formed by sequentially forming a plurality of image sections by repeatedly moving a single or plurality of

recording heads comprising a plurality of aligned ink ejecting orifices, in a scanning manner in the direction different from the direction in which the ink ejecting orifices are aligned, is characterized in that in order to form images in which the so-called border streaks are as imperceptible as possible, the portion of the image formation data corresponding to one or both of the first and last rasters of a given scanning track of the recording head, is divided into a plurality of processual data units equivalent to a predetermined number of dots; the theoretical amount by which ink is to be ejected by the ink ejecting orifices corresponding to one or both of the first and last rasters, according to a given processual binary image formation data, while they are moving across the portion of recording medium corresponding to each processual data unit, is calculated; and the amount by which ink is ejected by the ink ejecting orifices corresponding to one or both of the first and last rasters is reduced, based on the calculated theoretical amount, by dot-thinning, that is, by reducing the number of dots to be printed on the portion of the recording medium corresponding to the given processual data unit.

According to this method, the amount by which ink is ejected along the border between two adjacent image section corresponding to two adjacent scanning

tracks can be corrected using the binary image formation data, making it unnecessary to modify the processes carried out by the external apparatus such as a computer. In other words, the process for minimizing the possibility that the unwanted streaks will be effected at the border between two adjacent image section corresponding to two adjacent scanning tracks can be carried out on the ink jet apparatus side.

Also according to this method, the portion of the image formation data corresponding to the rasters corresponding to the target areas for correction are divided into a plurality of relatively small processual data units, making it possible to reduce process load without reducing print quality.

According to another aspect of the present invention, an ink jet recording method, in which an image is incrementally formed by sequentially forming a plurality of image sections by repeatedly moving a plurality of recording heads, one for each color, comprising a plurality of aligned ink ejecting orifices, in a scanning manner in the direction different from the direction in which the ink ejecting orifices are aligned, is characterized in that the portion of the image formation data corresponding to one or both of the first and last rasters of each scanning track of each recording head is divided into

a plurality of processual data units equivalent to a predetermined number of dots; and a correction process (dot-thinning process) in which the amount, in terms of dot count, by which the ink of a given color is ejected by the ink ejecting orifice corresponding to the raster next to the border between two adjacent scanning tracks while the ink ejecting orifice is scanning the recording medium section corresponding to each processual data unit, is reduced, based on the theoretical amount by which the ink of the given color is to be ejected, according to the given processual binary image formation data, by the ink ejecting orifices for the given color corresponding to one or both of the first and last rasters of the scanning track, while the ink ejecting orifices are scanning the recording medium section corresponding the given processual data unit, and also, the total of the theoretical amounts, in terms of dot count, by which the inks of the colors other than the given color are ejected, according to the same processual binary image formation data unit, by the ink ejecting orifices for the colors other than the given color corresponding to the same raster or rasters of the same scanning track, while the ink ejecting orifices are scanning the same recording medium section, is sequentially carried out for all the processual data units of all colors; and the ink ejecting orifices corresponding in position to

the first or last raster of a given scanning track are made to eject ink by the corrected amounts while they are moving across the recording medium portion corresponding to the given processual data unit to reduce the number by which dots are printed while the ink ejecting orifices are scanning across the recording medium portion corresponding to the given processual data unit.

It is preferable that the aforementioned ink dot-thinning process is carried out with reference to a single or plurality of prepared correction tables containing the correct amount by which the ink of a given color should be ejected by the ink ejecting orifice corresponding to the first or last raster of a given scanning track of the recording head while the ink ejecting orifice is scanning the recording medium portion corresponding to a given processual data unit, along with the amount by which the ink of the given color is ejected by the ink ejecting orifice for the ink of the given color corresponding to the first or last raster of a given scanning track of the recording head, according to the given binary image formation data unit, while the ink ejecting orifice is scanning the recording medium portion corresponding to the given processual data unit, and the total of the amounts by which the inks of the colors other than the given color are ejected by the ink ejecting orifices

for the inks of the colors other than the given color corresponding to the same raster, according to the same processual binary image formation data unit, while the ink ejecting orifices are scanning the same recording medium portion. The usage of the prepared correction tables can speed up the correction process. Further, the preparation of a plurality of correction tables according to the correction target, for example, image section, color, recording medium type, etc., makes it possible to carry out in a more appropriate manner the correction process for minimizing the possibility of the occurrence of the border streak.

An ink jet recording apparatus in accordance with the present invention, which incrementally forms an image on recording medium by sequentially forming a plurality of image sections in the form of a band by repeatedly moving its single or plurality of recording heads comprising a plurality of aligned ink ejecting orifices, in a manner to scan the recording medium in the direction different from the direction in which the ink ejecting orifices are aligned, is characterized in that it comprises a means for dividing the portion of binary image formation data corresponding to one or both of the first and last rasters of a given scanning track of the recording head, into a plurality of processual image formation

data units equivalent in size to a predetermined number of ink dots, and calculating the theoretical amount by which the ink ejecting orifice or orifices corresponding to one or both of the first and last rasters while the ink ejecting orifice or orifices are scanning the portion of the recording medium corresponding to the given processual image formation unit, and a thinning means for reducing the amount, in terms of dot count, by which ink is ejected by the ink ejecting orifices or orifices corresponding to one or both of the first and last rasters of the given scanning track of the recording head, in a manner to reduce the number of ink dots printed while the orifice or orifices are scanning the portion of the recording medium corresponding to the given processual image formation data unit, in order to minimize the possibility of the occurrence of the unwanted streak at the borders between two adjacent portions of the image corresponding to two adjacent scanning tracks of the recording head.

The above described thinning means is desired to carry out the thinning process with reference to a single or plurality of prepared correction tables containing the theoretical amount by which ink is to be ejected, and the corrected amount by which ink should be ejected.

Regarding the above described correction

tables, a plurality of correction tables may be individually prepared according to ink color, one for one. The usage of the correction tables speeds up the correction processes.

The correction tables contain the corrected amounts by which ink should be ejected, which were determined based on, for example, the theoretical amounts by which the ink of a given color is to be ejected by the ink ejecting orifice or orifices corresponding to one or both of the first and last rasters of a given scanning track of the recording head while the ink ejecting orifice or orifices are scanning the portion of recording medium corresponding to a given processual image formation data unit, and the total of the theoretical amounts by which the inks of the colors other than the given color are ejected by the ink ejecting orifices other than the ink ejecting orifice for the ink of the given color, corresponding to the same raster or rasters, according to the same processual image formation data unit, while they are scanning the same portion of the recording medium.

There may be prepared a plurality of correction tables according to the type of recording condition inclusive of at least the type of recording medium, in order to make it possible for the correction tables to be selectively used according to

the recording condition type.

The priority order in which a given dot within a set of ink dots corresponding to a given processual image formation data unit is eliminated is desired to be prepared based on its position within the set of the ink dots. Further, it is desired to be prepared so that when two or more ink dots in the set of the ink dots are to be eliminated, any two ink dots to be sequentially eliminated will not be adjacent to each other.

It is desired that when the dot-thinning process is carried out on both the portion of the image formation data corresponding to the first raster of a given scanning track of the recording head and the portion of the image formation data corresponding to the last raster of the preceding scanning track of the recording head, the priority order in which each ink dot is eliminated from the first raster is differentiated from the priority order in which each ink dot is eliminated from the last raster.

[Detailed Description of the Invention]

Hereinafter, the preferred embodiments of the present invention will be described in detail with reference to the appended drawings.

Figure 1 is a block diagram showing the general structure of the ink jet recording apparatus in accordance with the present invention. In the

drawing, a reference code 11 stands for a CPU for controlling the overall operation of the apparatus, and a referential code 12 stands for a RAM used as an operational region for the CPU 11 and a temporary data storage region. Designated by a referential code 13 is a ROM, in which the programs and data for driving the ink jet recording apparatus are stored, and which is used by the CPU 11. Designated by a referential code 14 is an interface portion through which the image forming apparatus is connected to an external apparatus (unshown) such as a computer, and also, through which binary data are transferred to the ink jet recording apparatus. Designated by a referential code 15 is a liquid crystal display for displaying the graphic man/machine interfaces, and designated by a referential code 16 is a keypad for selecting the various settings of the ink jet recording apparatus. A referential code 17 stands for a printing portion employing a single or plurality of ink jet heads, and a referential code 18 stands for a system bus for connecting the CPU 11 to various elements in the apparatus.

The printing portion 17 comprises four ink jet heads for ejecting four different inks, that is, black (K) ink, cyan (C) ink, magenta (M) ink, and yellow (Y) ink, one for one. In this embodiment, each ink jet head has 128 nozzles, and ejects ink droplets in

response to binary image formation data.

Figure 2 is a flowchart of the image formation process, showing from the input data reception to the actual printing, of the image forming apparatus in accordance with the present invention.

First, the image formation data are received from an external source (S21). The received data are analyzed and divided into a plurality of blocks of printing data, each of which corresponds to an image section printable by a single scanning run of the ink jet recording apparatus in the primary scanning direction (S22). Next, the amount of each color ink to be ejected (in terms of dot count) is computed for the first and last rasters of the first scanning track of the ink jet head (S32). Then, the printing data are corrected with reference to a single or plurality of correction tables 28 (S24). Then, in order to print an image, each ink jet head is driven based on the image formation data corrected as described above (S25). The above described process is repeated until the entirety of the image is completed (S26).

Figure 3 is a drawing for describing the correction process carried out for correcting the amount by which ink is ejected from each ink jet head. In this case, the amount by which ink is ejected onto the areas of a recording medium corresponding to the first and last rasters of each scanning tracks the

ink jet head is corrected, except that the amount by which ink is ejected onto the areas of the recording medium corresponding to the first raster of the first scanning track and the last raster of the last scanning track is not corrected.

For example, if the number of the nozzles each ink jet head has is 128, the number of nozzles per scanning track is also 128. Thus, the ink droplets ejected by the first and 128th nozzles are the targets of the correction. All nozzles do not necessarily eject ink while scanning recording medium. Therefore, the nozzles which are to be controlled in terms of the amount by which ink is ejected therefrom are not necessarily the first and last nozzles of the single column of nozzles.

Although, in this embodiment, the portions of the image formation data corresponding to the first and last rasters of each scanning track are selected as the correction targets, the portions of the image formation data corresponding to two or more rasters on one or both of the starting and ending sides of each scanning track may be selected as the targets for correction. In particular, when recording medium which is likely to suffer from bleeding is used, it is desired to make corrections for the portions of the image formation data corresponding to two or more rasters. In other words, whether corrections should

be made for the portions of image formation data corresponding to one or two rasters on one or both of the starting and ending sides of each scanning track may be determined based on the properties of an individual ink jet recording apparatus and the predicted amount of the bleeding (one of paper properties) which a given recording medium suffers.

Next, the process for correcting the amount by which ink is ejected by the ink ejecting orifices adjacent to the border between two adjacent scanning tracks will be described.

First, the image portion straddling the border of the two adjacent scanning tracks is divided into a predetermined number of areas which are identical in shape and size. In consideration of the relationship between the amount of work and the effects thereof, the portion of the image formation data corresponding to the image portion corresponding to the last raster of the preceding scanning track and the first raster of the following scanning track is selected as the correction target. The portion of image formation data corresponding to each raster is divided into a plurality of processual image formation data units equivalent to 5 x 1 dot matrix. However, this division is not intended to limit the scope of the present invention. In other words, as described above, the portion of the image formation data, for

which the ejection amount correction is made, does not need to be limited in size so that this portion of the image formation data encompasses only a single raster on each side of the border. Further, the dot count in each matrix does not need to be limited to five.

Figure 4 is a schematic drawing of the image formation data (for Y, M, C, and K colors) which correspond to a given image portion encompassing a single raster divided into a plurality of 5 x 1 dot matrixes. The right end matrixes, that is, the incomplete matrixes, cannot be properly processed by the correction process to which the rest are subjected, and also, leaving them unprocessed has little effect upon the outcome of the correction process. Therefore, these matrixes are omitted from the correction targets.

The correction process is carried out for the portion of the image formation data corresponding to each of the image portions straddling the border between two adjacent scanning tracks, and also, for each color. For example, in order to obtain the correct amount by which yellow ink should be ejected from the orifices corresponding to a given processual image formation data unit, first, the theoretical number ($0 \leq x \leq 5$) of times yellow ink is to be ejected by the yellow ink ejecting orifice corresponding to the processual image formation data

unit, according to the processual image formation data unit, while the ink ejecting orifice is scanning the portion of recording medium corresponding to the processual image formation data unit, as well as the total y ($0 \leq x \leq 15$) of the theoretical numbers of times magenta, cyan, and black inks are each ejected by the magenta, cyan, and black ink ejecting orifices corresponding to the same processual image formation data unit, according to the same image formation data unit, while they are scanning the same portion of the recording medium, are obtained. Then, the correct amount by which yellow ink should be ejected is obtained from a correction table, which was prepared through experiments, and which contains the theoretical dot count z ($0 \leq x \leq 5$) capable of minimizing the possibility of the occurrence of the border streak between two adjacent image portions corresponding to the two adjacent scanning tracks. As for the correction table, it is prepared for each of the four inks different in color. The correction table for the ink of a given color shows the relationship among the amount x by which the ink of the given color is ejected according to the original image formation data, the total y of the amounts by which the inks other than the ink of the given color are each ejected according to the original image formation data, and the correct dot counts z ($0 \leq x \leq 5$) which minimize

the possibility of the occurrence of the border streak between two image portions corresponding to two adjacent scanning tracks. Thus, there are four correction tables Y, M, C, and K, one for each color. Therefore, a proper correction value can be obtained for each color. However, this embodiment is not intended to exclude a table setup different from the one in this embodiment, for example, a setup in which a single common correction table is used for all four colors, a setup in which one common correction table is prepared for correcting the amount by which the Y, M, and C inks are ejected, and another correction table is prepared exclusively for correcting the amount by which K ink is ejected.

Thus, the correct value for the amount by which the ink of a given color should be ejected can be obtained by referring to the correction table, which contains the values of the x and y obtained from the original binary image formation data, and the correct values corresponding to the values of the x and y. Then, the amount by which the ink of the given color is ejected from the ink ejecting orifice corresponding to the processual image formation data unit is reduced in the following manner. For example, when the value of the dot count x for yellow color corresponding to a given processual image formation data unit is 5, and the value of the total y of the

dot counts for the colors other than yellow corresponding to the same processual image formation data unit is 3, the correct value, in terms of dot count, of the amount by which yellow ink should be ejected by the ink ejecting orifice corresponding to the given processual image formation data is 1. The correction process is carried out for each of the other colors. It will be described later which dot or dots within a set of dots corresponding to a given processual image formation data unit are to be eliminated when the dot count for a given color must be reduced.

Figure 7 is a correction table 28, that is, a concrete example of the correction table, in which the dot count corresponding to a given processual image formation data unit is 5. As described before, the relationship among the amount x by which the ink of a given color is to be ejected according to the original binary image formation data, and the total y of the amounts by which the inks of the colors other than the given color are ejected according to the original binary image formation data, and the ideal amount by which the ink of the given color should be eject to minimize the possibility of the occurrence of the border streak between two adjacent image portions corresponding to two adjacent scanning tracks, is predetermined for each color (Y, M, C, or K) through

experiments, and is presented in the form of the correction table for each color.

Two separate correction tables may be prepared for the plurality of the processual image formation data units for the first raster of a given scanning track, and those for the last raster of the same scanning track, one for one. Such an arrangement makes it possible to make the processual image formation data unit corresponding to first raster different in correction value from that corresponding to the last raster, providing a finer correction process.

Figure 5 is a schematic drawing showing how the amount by which the ink of a given color is ejected by the ink ejecting orifice corresponding to a given processual image formation data unit is reduced, more specifically, the priority order in which each of the set of dots corresponding to the given processual image formation data unit is eliminated (dot-thinning process). The priority order is set so that two adjacent numerical values representing the priority order in which each of the set of dots corresponding to the given processual image formation data unit do not become sequential. The priority order is also set so that a given processual image formation data unit corresponding to the last raster (raster immediately above border) of the preceding scanning track and the

locationally corresponding processual image formation data unit corresponding to the first raster (raster immediately below border) of the following scanning track become different in the priority order for dot elimination. In this embodiment, the priority numbers of the first to fifth dots, listing from the left side, corresponding to a given processual image formation data unit corresponding to the last raster, in terms of the order in which the dots are subjected to the dot-thinning process are, 1, 3, 5, 2, and 4, and the priority number of the first to fifth dots, also listing from the left side, corresponding to a given processual image formation data unit corresponding to the first raster, in terms of the order in which the dots are subjected to the dot-thinning process, are 5, 3, 1, 4, and 2. The objective of making the priority number in terms of the subjection to the dot-thinning process different from the ordinal number in terms of position is to prevent the dot-thinning process from degrading image quality. The above arrangement of the priority number is just an example, and is not intended to limit the scope of the present invention.

To describe more concretely, if the theoretical amount, in terms of dot count, by which the ink of a given color is ejected by the ink ejecting orifice corresponding to a given processual

image formation data unit corresponding to the last raster of a given scanning track, according to the original image formation data, is 4, and the correct amount, in terms of dot count, found in the correction table 28 with reference to the total of the amounts by which the inks of other colors are ejected, is 1, the amount in terms of dot count, by which the ink of the given color is ejected, is reduced from 4 to 1, being reduced by 3 dots; it must be reduced by 3 dots. Thus, first, it is checked whether or not the first dot, counting from the left side, is to be printed according to the given processual unit of the inputted image formation data. If the first dot is to be printed according to the given processual unit of the inputted image formation data, control is executed so that this dot is not printed. If the first dot is not to be printed according to the given processual unit of the inputted image formation data, it is checked whether or not the second dot is to be printed. If the second dot is to be printed, control is executed so that the second dot is not printed. This process is consecutively carried out, following the priority order, until the dot density is reduced by three dots (in other words, until ink ejection amount in terms of dot count is reduced to 1). The process for thinning the dots corresponding to the first raster is carried out following the priority order different from that

for the last raster, as described before.

Figure 6 is a schematic drawing showing the portions of an image corresponding to a plurality of processual image formation data units, one for one, and the sets of dots encompassed by the portions of the image, in another embodiment of the present invention. Referring to Figure 6(a), on the top side of the border, the portions of the image corresponding to the last two rasters, that is, n-th and (n-1)-th rasters of the preceding scanning track are subjected to the dot-thinning process, and the image portion corresponding to the last two rasters is divided into a plurality of processual units equivalent to 5 x 2 dot matrix, whereas on the bottom side of the border, the image formation data corresponding to the image portion corresponding to the first raster of the following scanning tracks is divided into a plurality of processual image formation data units equivalent to 5 x 1 dot matrix, as in Figure 5. The top and bottom sides of the border may be reversed in the number of the rasters, the image formation data for which are subjected to the dot-thinning process; a single raster on the top side and two rasters on the bottom side.

Figure 6(b) depicts a case in which the image formation data corresponding to two rasters are process on both the top and bottom sides of the border, and the image formation data for the image

portions corresponding to the two rasters on the top and bottom sides of the border are divided into a plurality of processual image formation data units equivalent to 5 x 2 dot matrix.

The dot matrix configurations shown in Figure 6 are remarkably effective when images are recorded on recording medium susceptible to bleeding. The numerical values in the drawings represent the priority order in which each of the set of dots corresponding to a given processual image formation data unit is subjected to the dot-thinning process. Also in this case, the priority is set so that the ordinal numbers for two adjacent dots do not become sequential.

Heretofore, some of the preferable embodiments of the present invention were described, and the present invention encompasses the various modifications of these embodiments.

As for an example of the modifications of the preceding embodiments, it may be on only one side of the border where corrections are made to the amounts by which inks are ejected from the orifices next to the border.

Further, a plurality of discrete correction tables such as the above described correction table may be prepared according to the range of the amount of the bleeding which various recording media suffer,

so that a correction table appropriate in terms bleeding can be selected according to the recording medium selection by a user. Further, there are various kinds of recording media, for example, ordinary paper, coated paper, glossy paper, film, etc. Thus, with the preparation of the plurality of the correction tables according to the various properties of recording medium, the table selection can be switched according to the properties of each medium, a group of media, etc.

In anticipation of situations in which the values found in the correction tables (primary tables) prepared through experiments do not provide satisfactory results due to the variation in the remaining amount of ink, ambient temperature, ambient humidity, variation among recording mediums, etc., a plurality of auxiliary correction tables may be prepared (or calculated) by multiplying the values in the primary correction tables by a coefficient in the range of 0.5 - 1.5 (fractions are rounded to nearest whole number), so that the values in the auxiliary correction tables can be selected prior to the actual printing operation. The preparation of such auxiliary correction tables makes the preceding embodiments of the present invention more effective.

In the preceding embodiments, the values in the correction tables represented the correct amount,

in terms of dot count, by which ink should be ejected in order to minimize the possibility of the occurrence of the border streak between two adjacent image portions corresponding to two sequential scanning tracks of the ink jet recording head. However, the correction tables may be set up so that the values represent the number by which dots should be thinned.

[Effects of Invention]

According to the present invention, the amount by which ink is ejected along the border between two adjacent scanning tracks can be corrected with the use of the binary image formation data, making it possible to carrying out on the ink jet recording side, the correction process for making it possible to form images, in which the border lines between two adjacent image sections corresponding to two adjacent scanning tracks is as imperceptible as possible, eliminating the need for the image formation data to be modified on the side of a host apparatus such as a computer. Further, according to the present invention, the image formation data are divided into a plurality of relatively small data blocks which are sequentially subjected to the correction process. Therefore, process load is reduced without sacrificing print quality. Moreover, according to the present invention, correction tables are prepared to make it possible to quickly carry out the correction process.

Further, a plurality of correction tables are individually prepared according to the image areas targeted for correction, image color, recording medium type, etc., making it possible to carrying out the correction process in the most appropriate manner for forming images in which the border lines are as imperceptible as possible.

[Brief Description of the Drawings]

Figure 1 is a block diagram for showing the general structure of a typical ink jet recording apparatus in accordance with the present invention.

Figure 2 is a flowchart of the correction process starting from the reception of the data from the ink jet recording apparatus shown in Figure 1 to the actual printing.

Figure 3 is a schematic drawing for depicting the correction process, in one of the embodiments of the present invention, for correcting the amount by which ink is ejected.

Figure 4 is a schematic drawing for showing the four sets of image formation data for Y, M, C, and K colors, one for one, each of which is divided into a plurality of blocks of data, or processual data units, each of which is equivalent to 5 x 1 dot matrix.

Figure 5 is a schematic drawing for showing the priority order in which the set of ink ejecting

orifices corresponding to each processual data unit are controlled to reduce the amount by which ink is ejected from the set of ink ejecting orifices, in one of the embodiments of the present invention.

Figure 6 is a schematic drawing for showing the priority order in which the set of ink ejecting orifices corresponding to each processual data unit are controlled to reduce the amount by which ink is ejected from the set of ink ejecting orifices, in another embodiment of the present invention.

Figure 7 is a concrete example of a set of correction tables in which the dot count in each processual data unit is 5, in one of the embodiments of the present invention.

[List of Reference Numerals]

11: CPU

12: RAM

13: ROM

14: interface portion (I/F)

15: liquid crystal display

16: key pad

17: printing portion

8: system bus

28: correction table

[Document]

Abstract

[Abstract]

[Object of the Invention]

To provide a single-pass ink jet recording apparatus capable of processing binary image formation data in order to form images, in which border lines between two adjacent image sections corresponding to two adjacent scanning tracks are as imperceptible as possible.

[Solution]

The portion of the binary image formation data corresponding to one or both of the first and last rasters of each scanning track of a recording head is divided into a plurality of small processual data units equivalent in size to a predetermined number of dots, and the theoretical amount by which ink is to be ejected from the set of ink ejecting orifices corresponding to each processual data unit is calculated based on the processual data unit. Then, the amount by which ink is ejected by the set of ink ejecting orifices is reduced based on the calculated theoretical amount, in the manner to reduce the number of dots to be formed along the border. This dot-thinning process is carried out with reference to the correction tables prepared in advance to show the

relationship among the amount by which the ink of a given color is to be ejected according to a given processual data unit, the total of the amounts by which inks of colors different from the given color are ejected according to the same processual data unit, and the correct amount by which the ink of the given color should be ejected by the set of ink ejecting orifices corresponding to the given processual data unit.

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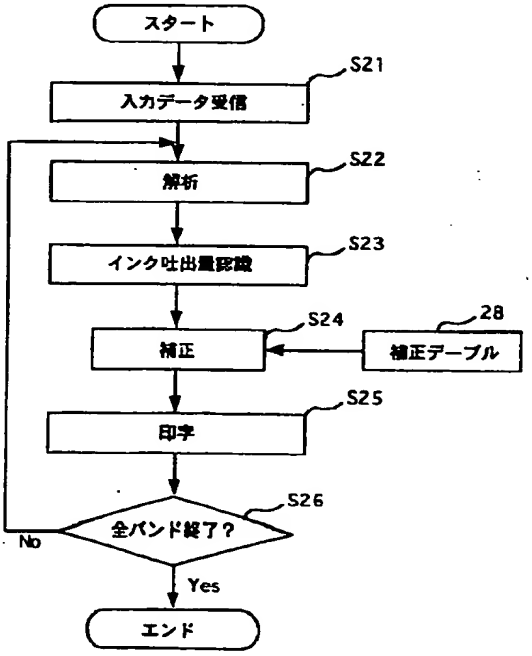
(54)【発明の名称】　インクジェット記録方法および装置

(57)【要約】

【課題】二値化された画像データに基づくインクジェット記録装置側での処理により、バンドの境界部のつなぎスジの発生を緩和することのできるシングルパス方式のインクジェット記録装置を提供する。

【解決手段】記録ヘッドの１回の走査により記録される１バンドの少なくとも第１ラスタおよび最終ラスタの一方を、おのおの予め定めた個数のドットからなる複数の単位領域に分割し、２値化画像データに基づいて、前記単位領域毎に、インク吐出量を認識する。この認識されたインク吐出量に基づいて、当該単位領域内のインク吐出量を低減するよう、吐出すべきインクドットの間引き処理を行う。この間引き処理は、各単位領域内の注目した色のインク吐出量と、当該単位領域内の他の色のインク吐出量の合計とに応じて、前記注目した色のインク吐出量を予め定めた補正テーブルを参照することにより行う。



【特許請求の範囲】

【請求項１】インクを吐出する複数の吐出口を配列した記録ヘッドを、前記吐出口の配列方向と異なる方向に繰り返し走査して順次バンド単位に画像記録を行うインクジェット記録方法において、

前記記録ヘッドの１回の走査により記録される１バンドの少なくとも第１ラスタおよび最終ラスタの一方を、おのおの予め定めた個数のドットからなる複数の単位領域に分割し、

２値化画像データに基づいて、前記単位領域毎に、インク吐出量を認識し、この認識されたインク吐出量に基づいて、当該単位領域内のインク吐出量を低減するよう、吐出すべきインクドットの間引き処理を行うことにより、バンドとバンドの境界におけるつなぎスジの発生を緩和することを特徴とするインクジェット記録方法。

【請求項２】インクを吐出する複数の吐出口を配列した記録ヘッドを複数の色毎に用い、前記吐出口の配列方向と異なる方向に前記記録ヘッドを繰り返し走査して順次バンド単位に画像記録を行うインクジェット記録方法において、

前記記録ヘッドの１回の走査により記録される１バンドの少なくとも第１ラスタおよび最終ラスタの一方を、おのおの予め定めた個数のドットからなる複数の単位領域に分割し、

２値化画像データに基づいて、各単位領域内の注目した色のインク吐出量と、当該単位領域内の他の色のインク吐出量の合計とに応じて、前記注目した色のインク吐出量を低減するよう補正し、

この補正を前記単位領域内の他の色について順次繰り返し実行し、さらに、補正対象のラスタ内のすべての単位領域について上記補正を順次繰り返し実行し、

このように各単位領域について、補正されたインク吐出量で各注目した色のインク吐出を行うよう前記単位領域内の注目した色の吐出すべきインクドットの間引き処理を行うことを特徴とするインクジェット記録方法。

【請求項３】前記インクドットの間引き処理は、各単位領域内の注目した色のインク吐出量と、当該単位領域内の他の色のインク吐出量の合計とに応じて、前記注目した色のインク吐出量を予め定めた補正テーブルを参照することにより行う請求項２記載のインクジェット記録方法。

【請求項４】インクを吐出する複数の吐出口を配列した記録ヘッドを前記吐出口の配列方向と異なる方向に繰り返し走査して順次バンド単位に画像記録を行うインクジェット記録装置において、

２値化画像データに基づいて、各バンドの少なくとも第１ラスタおよび最終ラスタの一方を、おのおの予め定めた個数のドットからなる複数の単位領域に分割し、各単位領域内のインク吐出量を求める手段と、

この求められたインク吐出量に基づいて、当該単位領域内のインク吐出量を低減するよう、吐出すべきインクドットの間引き処理を行う間引き手段とを備え、

間引き処理により、バンドとバンドの境界におけるつなぎスジの発生を緩和することを特徴とするインクジェット記録装置。

【請求項５】前記間引き手段は、インク吐出量とこれに対応する補正されたインク吐出量とを予め定めた補正テーブルを用いて、前記間引き処理を行うことを特徴とする請求項４記載のインクジェット記録装置。

【請求項６】前記補正テーブルは、補正の対象とするインクの色毎に別個に設ける請求項５記載のインクジェット記録装置。

【請求項７】前記補正テーブルは、２値化画像データに基づいて、各単位領域内の注目した色のインク吐出量と、当該単位領域内の他の色のインク吐出量の合計とに応じて、前記注目した色の補正後のインク吐出量を定めたことを特徴とする請求項５または６記載のインクジェット記録装置。

【請求項８】前記補正テーブルは、少なくとも被記録媒体の種類を含む記録条件に応じて複数設けられ、当該条件に応じて使い分けられる請求項５、６または７記載のインクジェット記録装置。

【請求項９】前記単位領域内のインクドットの間引きにおいて、間引きの対象となるドットの優先順位が各単位領域のドット位置に応じて予め定められていることを特徴とする請求項４～８のいずれかに記載のインクジェット記録装置。

【請求項１０】バンドの第１ラスタおよび最終ラスタをドット間引きの対象とする場合、第１ラスタと最終ラスタとで前記間引きの対象となるドットの優先順位を異ならせることを特徴とする請求項９記載のインクジェット記録装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、シングルパス方式で記録を行うインクジェット記録装置に関するものである。

【０００２】

【従来の技術】インクジェット記録装置では、通常、インクを吐出する複数の吐出口（ノズル）を配列した記録ヘッドを吐出口の配列方向と異なる方向に繰り返し走査して画像記録を行うことから、一度の走査で帯状の画像領域（バンド）が形成される。この際、被記録媒体の材質や表面状態に応じてインクがにじむ場合がある。その場合、バンドとバンドの境界にいわゆる「つなぎスジ」と呼ばれる画像ムラが生じることがある。

【０００３】これを防ぐためには、同じバンドを複数回に分けて記録するマルチパスによる方式を採用すればよいが、マルチパス方式では記録速度が低下してしまうという問題がある。

【０００４】
【発明が解決しようとする課題】シングルパス方式のインクジェット記録装置においてつなぎスジを防止する技術として、例えば特開平７－８９０９９号に開示のものがある。これは、バンドとバンドの境界部で記録される信号（多値信号）の信号値を小さくすることでにじみを押さえ、つなぎスジを防止するものである。
【０００５】しかしながら、上記従来例では画像信号レベルで補正を行っているため以下のような欠点があった。
【０００６】すなわち、第一に、一般に普及しているインクジェット記録装置の多くはコンピュータ端末装置と接続されており、コンピュータ端末装置で２値化等の画像処理を行いインクジェット記録装置に転送して記録している。しかし、インクジェット記録装置に多値信号を取り扱う画像入力部や画像処理部を持たせるとコストや処理時間が増加するため普及機では一般的でない。よって、インクジェット記録装置が画像信号レベルでの補正を行うと多階調画像を２値化画像に変換する処理に時間を浪費するため記録速度が遅くなってしまう。本発明のインクジェット記録装置は、多値の信号レベルを補正するのではなく、２値の画像データを補正処理の対象とするものである。
【０００７】第二に、個々のインクジェット記録装置や被記録媒体によって紙送り量の誤差の個体差やインクにじみ量が変化するためこれらの補正をするには上記従来例では難しい。また、コンピュータ端末装置等で補正処理を行おうとすると、インクジェット記録装置の正確なバンド間の境界部分が分からない場合、処理が困難となる。
【０００８】そこで、本発明は上記の課題を解決するためになされたもので、二値化された画像データに基づくインクジェット記録装置側での処理により、バンドの境界部のつなぎスジの発生を緩和することのできるシングルパス方式のインクジェット記録装置を提供することを目的とする。
【０００９】本発明による他の目的は、インクジェット記録装置の個体差や被記録媒体固有のにじみ量の違いに対応して境界部におけるつなぎスジの発生を緩和することのできるシングルパス方式のインクジェット記録装置を提供することにある。
【００１０】
【課題を解決するための手段】上記目的を達成するため本発明は、インクを吐出する複数の吐出口を配列した記録ヘッドを、前記吐出口の配列方向と異なる方向に繰り返し走査して順次バンド単位に画像記録を行うインクジェット記録方法において、前記記録ヘッドの１回の走査により記録される１バンドの少なくとも第１ラスタおよび最終ラスタの一方を、おのおの予め定めた個数のドットからなる複数の単位領域に分割し、２値化画像データに基づいて、前記単位領域毎に、インク吐出量を認識し、この認識されたインク吐出量に基づいて、当該単位領域内のインク吐出量を低減するよう、吐出すべきインクドットの間引き処理を行うことにより、バンドとバンドの境界におけるつなぎスジの発生を緩和することを特徴とする。
【００１１】この構成によれば、２値化画像データを用いてバンドの境界部のインク吐出量を補正することができるので、外部のコンピュータ端末装置等における処理は何ら変更する必要なく、インクジェット記録装置側で補正処理を行い、走査（バンド）間の境界部のつなぎスジの発生を緩和を行うことができる。
【００１２】また、一度の補正処理の対象領域を比較的小さい単位領域に限定することにより、印字品質を低下させることなく、処理負荷を軽減することができる。
【００１３】本発明は、他の見地によれば、インクを吐出する複数の吐出口を配列した記録ヘッドを複数の色毎に用い、前記吐出口の配列方向と異なる方向に前記記録ヘッドを繰り返し走査して順次バンド単位に画像記録を行うインクジェット記録方法において、前記記録ヘッドの１回の走査により記録される１バンドの少なくとも第１ラスタおよび最終ラスタの一方を、おのおの予め定めた個数のドットからなる複数の単位領域に分割し、２値化画像データに基づいて、各単位領域内の注目した色のインク吐出量と、当該単位領域内の他の色のインク吐出量の合計とに応じて、前記注目した色のインク吐出量を低減するよう補正し、この補正を前記単位領域内の他の色について順次繰り返し実行し、さらに、補正対象のラスタ内のすべての単位領域について上記補正を順次繰り返し実行し、このように各単位領域について、補正されたインク吐出量で各注目した色のインク吐出を行うよう前記単位領域内の注目した色の吐出すべきインクドットの間引き処理を行うことを特徴とする。
【００１４】前記インクドットの間引き処理は、好ましくは、各単位領域内の注目した色のインク吐出量と、当該単位領域内の他の色のインク吐出量の合計とに応じて、前記注目した色のインク吐出量を予め定めた補正テーブルを参照することにより行う。補正テーブルを用いることにより、迅速な補正処理を行うことができる。補正テーブルは、補正の対象となる領域、色、被記録媒体の種類等に応じて別個に設けることにより、より適切なつなぎスジ緩和のための補正処理が行える。
【００１５】本発明によるインクジェット記録装置は、インクを吐出する複数の吐出口を配列した記録ヘッドを前記吐出口の配列方向と異なる方向に繰り返し走査して順次バンド単位に画像記録を行うインクジェット記録装置において、２値化画像データに基づいて、各バンドの少なくとも第１ラスタおよび最終ラスタの一方を、おのおの予め定めた個数のドットからなる複数の単位領域に分割し、各単位領域内のインク吐出量を求める手段と、

この求められたインク吐出量に基づいて、当該単位領域内のインク吐出量を低減するよう、吐出すべきインクドットの間引き処理を行う間引き手段とを備え、間引き処理により、バンドとバンドの境界におけるつなぎスジの発生を緩和することを特徴とする。

【００１６】前記間引き手段は、インク吐出量とこれに対応する補正されたインク吐出量とを予め定めた補正テーブルを用いて、前記間引き処理を行うことが好ましい。

【００１７】前記補正テーブルは、補正の対象とするインクの色毎に別個に設けてもよい。補正テーブルを用いることにより、迅速な補正処理を行うことができる。

【００１８】前記補正テーブルは、例えば、２値化画像データに基づいて、各単位領域内の注目した色のインク吐出量と、当該単位領域内の他の色のインク吐出量の合計とに応じて、前記注目した色の補正後のインク吐出量を定めたものである。

【００１９】前記補正テーブルは、少なくとも被記録媒体の種類を含む記録条件に応じて複数設けられ、当該条件に応じて使い分けられるようにしてもよい。

【００２０】前記単位領域内のインクドットの間引きにおいて、間引きの対象となるドットの優先順位が各単位領域のドット位置に応じて予め定めることが好ましい。この際、単位領域内の一部のドットが間引かれる場合に、それらの間引かれるドットが空間的に分散するように優先順位を定めることが好ましい。

【００２１】バンドの第１ラスタおよび最終ラスタをドット間引きの対象とする場合、第１ラスタと最終ラスタとで前記間引きの対象となるドットの優先順位を異ならせることが好ましい。

【００２２】

【発明の実施の形態】以下、本発明の実施の形態について、図面を参照して詳細に説明する。

【００２３】図１は本発明のインクジェット記録装置の構成を示すブロック図である。図１中、１１は装置全体の動作を制御するＣＰＵ、１２はＣＰＵ１１の作業領域およびデータの一時記憶領域として利用されるＲＡＭである。１３はインクジェット記録装置を駆動するためのプログラムやデータが書き込まれているＲＯＭであり、ＣＰＵ１１により使用される。１４は外部のコンピュータ端末装置等（図示せず）と接続するためのインタフェース部であり、これを介して２値データが転送されてくる。１５はマンマシンインタフェースのための表示を行うＬＣＤ表示装置、１６はインクジェット記録装置の各種設定を選択するためのキー操作部である。１７はインクジェットヘッドによる印字部、１８はＣＰＵ１１と他の各要素とを接続するシステムバスである。

【００２４】印字部１７のインクジェットヘッドには、ブラック（Ｋ）、シアン（Ｃ）、マゼンタ（Ｍ）、イエロー（Ｙ）の４色があり、本実施の形態ではそれぞれ１２８ノズルを持ち、２値化された画像データに対応してインク滴を吐出する。

【００２５】図２は入力データ受信から印字までの処理フローである。

【００２６】まず、外部から入力データを受信し（Ｓ２１）、この受信したデータを解析してインクジェットのヘッドによる記録に適した１バンド分の印字データを用意する（Ｓ２２）。次に、各色毎に第１および最終ラスタの各単位領域のインク吐出量（吐出ドット数）を認識し（Ｓ２３）、これに基づいて補正テーブル２８を参照して、印字データの補正を行う（Ｓ２４）。このようにして得られた当該バンドの補正後の画像データに基づいて各ヘッドを駆動して印字処理を行う（Ｓ２５）。このような処理をすべてのバンドが終了するまで（Ｓ２６）、繰り返して実行する。

【００２７】図３は、本実施の形態におけるインク吐出量の補正処理を説明するための図である。この例では、第１走査（第１バンド）の最終ラスタと第２走査（第２バンド）以降の第１ラスタおよび最終ラスタにおいてインク吐出量の補正を行う。最後のバンドでは、第１のラスタのみの補正を行う。

【００２８】例えば、１バンドの記録に関与する１色あたりのヘッドのノズル数を１２８とすると、第１と第１２８のノズルにより吐出されるインク滴が補正の対象となる。１バンドの記録に関与するノズルは、ヘッドに備えられたすべてのノズルである必要はない。すなわち、インク滴吐出の補正の対象となるノズルはヘッドに備えられた１列のノズル群の最初と最後のノズルとは限らない。

【００２９】また、本実施の形態では、補正の対象となるラスタをバンドの最初と最後の各１ラスタとしているが、少なくともその一方を２ラスタ以上とすることも可能である。特に、にじみの大きい場合に２ラスタ単位の補正が効果を発揮する。すなわち、バンドの一辺の補正対象ラスタを１ラスタとするか２ラスタとするかは、インクジェット記録装置の個体差や被記録媒体のインクのにじみ量（すなわち紙質）で決定することができる。

【００３０】次に、本実施の形態における、境界部でのインク吐出量の補正処理について説明する。

【００３１】まず、バンドの境界部を一定の形状および面積になるように分割する。仕事量と効果の関係から、本実施の形態における境界部はバンドの最初と最後の各１本のラスタとし、この各ラスタを横５ドット×縦１ドットの単位領域に分割した。しかし、本発明はこれに限定されるものではない。前述のように、被記録媒体に応じて単位領域のラスタ数は１ラスタではなく複数ラスタにしてもよく、また、１ラスタあたりのドット数も５ドットに限定するものではない。

【００３２】図４は、Ｙ，Ｍ，Ｃ，Ｋの各色の５ドット×１ドットの単位領域から構成される１ラスタのデータ

を模式的に示したものである。右端の５ドットに満たない部分は、画一的な処理が行えないことと、補正処理を行わなくても影響が少ないことから、本実施の形態では、補正処理の対象から外している。

【００３３】補正処理は、単位領域毎に、各色について行う。例えば、ある単位領域のＹのインク吐出量を補正の対象とするとき、その単位領域のイエローＹの吐出ドット数ｘ（０≦ｘ≦５）を求めるとともに、他の色Ｍ，Ｃ，Ｋの同じ単位領域内の吐出ドット数の合計値ｙ（０≦ｘ≦１５）を求める。この注目するインク色のインク吐出量ｘと、他のインク色のインク吐出量ｙの組み合わせに対応して、つなぎスジが最も緩和される適正なＹの吐出ドット数ｚ（０≦ｘ≦５）を予め実験的に求めて、これらの関係をその色に対応する補正テーブルに記憶しておく。したがって、補正テーブルはＹ，Ｍ，Ｃ，Ｋの４つ設けられる。これにより、色毎に適正な補正値を設定することができる。但し、本発明は、すべての色に共通の補正テーブルを用いる場合、あるいは、Ｙ，Ｍ，Ｃに共通の補正テーブルを用い、Ｋに専用の補正テーブルを用いる場合等を排除するものではない。

【００３４】ある色の単位領域のインク吐出量の補正処理時には、２値化画像データにより与えられたｘとｙの値に応じて、その色の補正テーブルを参照することにより、対応する補正値ｚが得られる。その補正値の吐出量になるように、当該単位領域内のその色のインク吐出量を減少させる。例えば、イエローＹのドット数ｘが５、他の色のドット数の合計値ｙが３の場合には補正後のイエローＹのドット数を１にする。着目する色を順次変えて、他の色についても同様の補正処理が行われる。ある色のドット数を低減する場合、単位領域内のどのドットを間引くかについては、後述する。

【００３５】図７に、単位領域のドット数を５とした場合の補正テーブル２８の具体例を示す。前述のように、注目する補正対象の色（Ｙ，Ｍ，Ｃ，Ｋ）毎に、与えられた単位領域内のその色のインク吐出量ｘと、他の色のインク吐出量の合計ｙのあらゆる組合せに対して、補正後の当該色のインク吐出量ｚを予め定めている。ｘ，ｙ，ｚの好ましい関係は、実験的に求めることができる。

【００３６】さらに、この補正テーブルは、バンドの第１ラスタ用と最終のラスタ用に別個のテーブルを用意するようにしてもよい。これにより、両ラスタの補正値を異ならせることができるので、さらにきめ細かな補正処理が可能となる。

【００３７】図５は、単位領域内でのインク吐出量減少（ドット間引き）の優先順位を示す図である。１つの単位領域内では、優先順位の隣り合う数値が空間的に連続しないように分散して並べている。また、あるバンドの最終ラスタ（境界部の上方のラスタ）と、次のバンドの第１ラスタ（同じ境界部の下方のラスタ）とで優先順位を異ならせている。この例では、吐出ドット間引きの優先順位は、最終ラスタについては、単位領域内の左端から順に、１、３、５、２、４とし、第１ラスタについては、５、３、１、４、２としている（数字の若い方が先に間引かれる）。このように優先順位の数値を不連続に分散させるのは、間引きの結果の画質の劣化を防止するためである。なお、これらの優先順位の各数値の位置はあくまで一例であり、本発明はこれに限定されるものではない。

【００３８】ここで、具体例を考える。例えば、入力画像データの与えられた１バンドの最終ラスタの単位領域内の注目するインク色のインク吐出量が４で、他のインク吐出量との組み合わせから補正テーブル２８内の当該補正量が１であったとする。この場合、インク吐出量は４から１へ、３ドット分減少するので、３ドットを間引く必要がある。そこで、まずその単位領域内の入力画像データの左端のドットを調べ印字することになっていたらこのドットを印字しないようにする。もし印字しないことになっていたら、次に右から２番目のドットを調べ、印字することになっていたらこのドットを印字しないようにする。このようにして、３ドットを間引く（すなわちインク吐出量を１とする）まで、優先順位に従って間引きの対象となる吐出ドットを探索していく。バンドの第１ラスタについては、前述のように別の優先順位でドットの間引きが行われる。

【００３９】図６に、本発明による他の実施の形態における単位領域の構成を示す。図６（ａ）は、単位領域を、境界の上側では、バンドの最終の第ｎラスタと第ｎ－１ラスタの２ラスタ分の横５ドット×縦２ドットの領域とし、境界の下側では図５と同様の１ラスタ分の横５ドット×縦１ドットの領域としたものである。逆に、境界の上側を１ラスタ分、下側を２ラスタ分としてもよい。

【００４０】図６（ｂ）は、境界の上側および下側を共に、２ラスタ分の横５ドット×縦２ドットの領域としたものである。

【００４１】図６の単位領域の構成は、インクのにじみが大きい被記録媒体に利用して効果を発揮する。それぞれの単位領域内の吐出ドットの間引きの優先順位の一例を図内に数値で示してある。この場合も、優先順位の隣り合う数値は空間的に連続しないように定められている。

【００４２】以上、本発明の好適な実施の形態について説明したが、種々の変更を行うことが可能である。

【００４３】例えば、本発明の変形例として、境界の上側または下側の一方でのみインク吐出量の補正を行うようにすることも可能である。

【００４４】また、上述した補正テーブルは、被記録媒体のインクのにじみ量によってそれにあったものを別個に用意しておき、ユーザによる用紙種別の選択に応じて

対応する補正テーブルを選択するとよい。一般に、普通紙、コート紙、光沢紙、フィルム等の種々の種類の被記録媒体があり、これらの個々のもの、またはグループに応じて、対応する補正テーブルを切り替えて使用することができる。

【００４５】さらに、印字時のインクの残量、気温、湿度、被記録媒体の個体差などで実験的に求めた補正テーブルの補正量が適合しないような場合は、補正テーブルの各数値に０．５から１．５程度の係数を乗じて（端数は四捨五入等を行う）得られた補正テーブルをいくつか用意しておき（あるいは、計算を行い）、それらを実際の印字前に選択できるようにすればさらに効果的といえる。

【００４６】以上の説明では、補正テーブルの出力として補正後のインク吐出量を定めたが、これに代えて、間引きドット数を規定するようにしてもよい。

【００４７】

【発明の効果】本発明によれば、２値化画像データを用いてバンドの境界部のインク吐出量を補正することができるので、外部のコンピュータ端末装置等における処理は何ら変更する必要なく、インクジェット記録装置側で補正処理を行い、走査（バンド）間の境界部のつなぎスジの発生を緩和を行うことができる。また、一度の補正処理の対象領域を比較的小さい領域に限定することにより、印字品質を低下させることなく、処理負荷を軽減することができる。さらに、補正テーブルを用いることにより、迅速な補正処理を行うことができる。補正テーブルは、補正の対象となる領域、色、被記録媒体の種類等に応じて別個に設けることにより、より適切なつなぎスジ緩和のための補正処理が行える。

【００４８】

【図面の簡単な説明】

【図１】本発明によるインクジェット記録装置の構成例を示すブロック図である。

【図２】図１のインクジェット記録装置の入力データ受信から印字までの処理フローを示すフローチャートである。

【図３】本発明の実施の形態におけるインク吐出量の補正処理を説明するための図である。

【図４】本発明の実施の形態におけるＹ，Ｍ，Ｃ，Ｋの各色の５ドット×１ドットの単位領域から構成される１ラスタのデータを模式的に示した図である。

【図５】本発明の実施の形態における単位領域内でのインク吐出量減少（ドット間引き）の優先順位を示した図である。

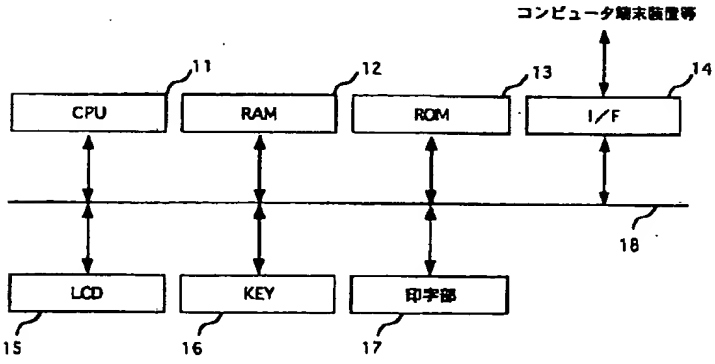
【図６】本発明による他の実施の形態における単位領域の構成を示す図である。

【図７】本発明の実施の形態における、単位領域のドット数を５とした場合の補正テーブルの具体例を示す図である。

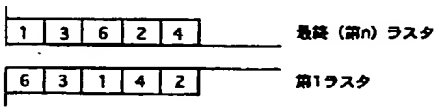
【符号の説明】

１１…ＣＰＵ、１２…ＲＡＭ、１３…ＲＯＭ、１４…インタフェース部（Ｉ／Ｆ）、１５…液晶表示装置（ＬＣＤ）、１６…キー操作部（ＫＥＹ）、１７…印字部、１８…システムバス、２８…補正テーブル。

【図１】

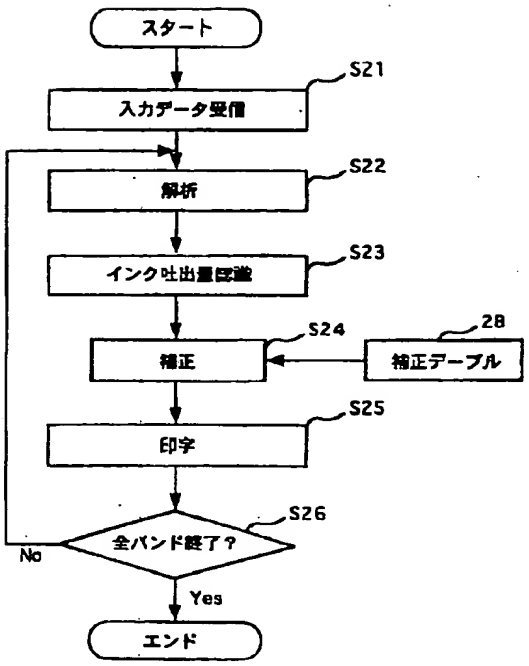


【図５】

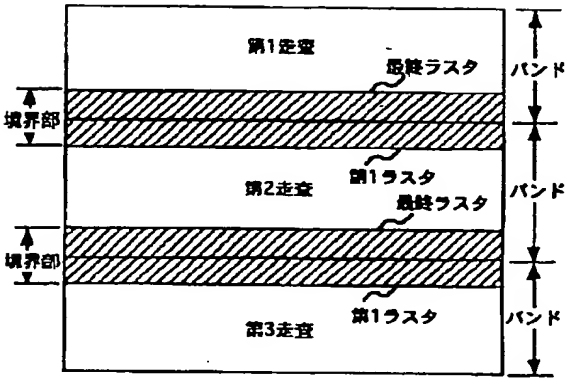


【図４】

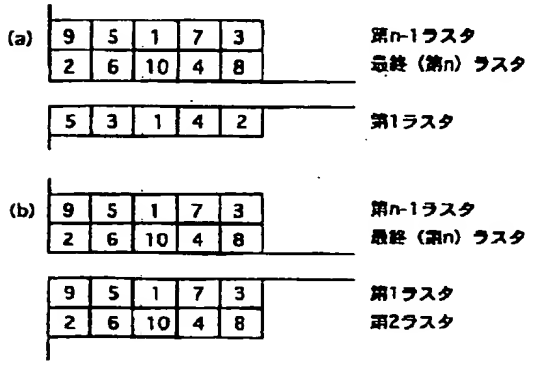
【図２】



【図３】



【図６】



【図７】

補正テーブル28

注目インク吐出量(x)	他色インク吐出量合計(y)	補正後インク吐出量(z)
5	0	2
5	1	2
5	2	2
5	3	1
5	4	0
5	5	0
5	6	0
5	7	0
5	8	0
5	9	0
5	10	0
5	11	0
5	12	0
5	13	0
5	14	0
5	15	0
4	0	2
4	1	2
4	2	1
4	3	0
4	4	0
≈		≈
3	0	3
≈	⋮	≈
2	0	2
≈	⋮	≈
1	0	1
	⋮	

Y
M
C
K